LAFAYETTE
CHEMICAL & BIOMOLECULAR ENGINEERING

Lafayette College Chapter of the American Institute of Chemical Engineers
Mid-Atlantic Regional Conference Research Paper Abstracts

Analyzing RT² Profiler PCR Arrays to Profile Cell-Matrix Interactions on Smart Biomaterials

Paper by Tyler Fruneaux
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Abstract: Thermoresponsive polymers (TRPs) have the potential to redefine cell culture and medicine in the future. These TRPs change their miscibility at a certain temperature (lower critical solution temperature, LCST), allowing for mechanical, as opposed to biochemical, cell release. This maintains cell-cell and cell-matrix interactions. The gold standard of TRPs is PNIPAM, which is commercially available and has a LCST of 32°C. We have been investigating the biocompatibility of another type of TRPs (copolymers of polymethacrylate and oligoethyleneglycol, PMO), which allows for a tunable LCST between 28 and 90°C. This work investigates the molecular mechanisms of cell adhesion on PMO brushes compared to PNIPAM and tissue culture plastic (TCP) on the basis of gene expression and morphological characterization. Gene expression is studied through RT-PCR with a group of genes coding for various extracellular matrix proteins. Experiments were conducted at both 2 and 24 hour time points to study the changes in gene expression over time as cells adhere to the substrates. Results show an increase in cell adhesion and differential gene expression as a function of both TRP substrate and LCST and highlight a potential opportunity to control cell adhesion and drive cell phenotype through the design of TRP substrates.

Effect of nanoparticle surface chemistry on adsorption and fluid phase partitioning in aqueous/toluene and cellular systems

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Paper by Dana Lapides

Abstract: Copolymers of di(ethylene glycol) methyl ether methacrylate (x = MeO_2MA) and oligo(ethylene glycol) methyl ether methacrylate (y = OEGMA) display lower critical solution phenomena in aqueous systems that are tunable by the copolymer ratio (x:y), ionic strength, and temperature. These properties enable tuning the hydrophobicity of macromolecular systems by variation of (x:y). For nanoparticles stabilized with these macromolecules, this provides a systematic approach to understanding the impact of surface chemistry, specifically hydrophobicity, on the equilibrium and transport properties of nanomaterials in biphasic systems. We synthesized a homologous series of gold nanoparticles capped by these copolymers, Au@(MeO_2MA_x-co-$OEGMA_y$). By varying the copolymer 95:5 < (x:y) < 80:20 ratio, we studied the effect of surface hydrophobicity on the nanoparticle equilibrium adsorption isotherm and phase transfer at the aqueous-toluene interface. The increase in hydrophobicity from (x:y)=80:20 to (x:y)=95:5 is accompanied by an increase in the fractional coverage of the aqueous-toluene interface from f=0.3 to f >1, or multilayer adsorption and an increase in the characteristic adsorption timescale from t_D=31 to t_D=450 seconds. The equilibrium partition coefficient for the aqueous/toluene systems, $K_{T/W}$ is also a strong function of (x:y), increasing from $K_{T/W}$(80:20) = 0.7 to $K_{T/W}$(95:5) = 9.8. We also observed an increase in cellular uptake for increasing (x:y) suggesting that surface chemistry alone plays a significant role in intercellular transport processes.